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Predicting the ability to lip-read in children who have a hearing loss

Jeanne Breitmayer Flowers

Predicting the Ability to Lip-Read in Children who have a Hearing Loss

by

Jeanne Breitmayer Flowers

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Nancy Tye-Murray, Ph.D., Independent Study Advisor

Abstract: This study aims to discover if a variety of factors related to a child's education and audiologic history predict a child's ability to lip-read.

Introduction

A variety of factors could potentially influence a child's ability to lip-read, such as a child's age, the child's current school placement, or the child's speech, language, and speech perception ability. If the child has a hearing loss, the age at which the child was identified with a hearing loss and the age at which the child was fitted with amplification could also influence lip-reading abilities. Unfortunately, little research has been conducted to determine which of these factors affect a child's ability to lip-read. Studies have been conducted on how these factors influence the child's language abilities and how some of these factors individually influence a child's ability to lip-read.

Yoshinaga-Itano, Sedey, Coulter, and Mehl (1998) found that a child with a hearing loss will benefit from early identification and amplification. Children whose hearing loss is identified early and who subsequently receive early intervention have better performance on language tests than those children who do not receive early identification and intervention (Yoshinaga-Itano, Sedey, Coulter, & Mehl, 1998). Language abilities can affect almost every aspect of a child who is hearing impaired including his/her ability to read and write. Language ability also influences a child's ability to lip-read according to Mogford (1987). It was found that a child's lip-reading ability is tied to their language ability in a circular fashion. In other words, if a child is hearing impaired, his/her ability to lip-read is dependent on his/her language level which would also be dependent on the ability to lip-read (Mogford, 1987). The ability to lip-read and language levels influence each other.

Because this interdependence exists between lip-reading ability and language abilities, it would seem that the way in which children with a hearing loss would learn oral language would be through lip-reading. Mogford (1987) believed that because children with a hearing loss have

an impaired auditory channel, they need to learn language through another sensory modality. If a child is learning oral language, it would seem that this modality would be the visual modality, and therefore, lip-reading. Seewald, Ross, Giolas, and Yonovitz (1985) go on to confirm this information by presenting children with auditory and visual stimuli that were not synchronized. They found that as hearing level increased to within the 80 to 90 dB HL range, a shift from use of auditory to visual perception was seen. This suggests that children with poorer hearing rely more on visual cues, while children with better hearing rely more on auditory cues (Seewald, Roos, Giolas, & Yonovitz, 1985).

Geers and Brenner (1994) conducted a study focusing on visual enhancement. While visual enhancement scores are not the same as lip-reading scores, they do demonstrate how much the visual modality aided the children when listening and understanding speech. Geers and Brenner (1994) defined lip-reading enhancement as "the difference between each child's scores…when administered with and without a sensory aid" (pp. 105). Three groups of children participated in the Geers and Brenner (1994) study: children who had a profound hearing loss and wore hearing aids; children who had a profound hearing loss and wore a cochlear implant; and children who had a less severe hearing loss. A hierarchy of tests designed to test lip-reading ability was given to each child. Each child did not receive all six tests in the battery because the score on the first test determined if they received a more difficult test. This study found that the children who had a profound hearing loss and wore cochlear implants and the children who had less severe hearing losses had better visual enhancement scores than those children with profound hearing losses who wore hearing aids (Geers & Brenner, 1994). From this, it could be concluded that the children with a profound hearing loss who wore a cochlear implant and the children with a less severe hearing loss were receiving the same benefit from the visual modality

being added, while the children with profound hearing losses who wore hearing aids did not receive as much benefit from the visual modality. If the children with a profound hearing loss who wore hearing aids did not benefit from the visual modality, in essence they might not be as good at lip-reading as their peers who have a profound hearing loss and use a cochlear implant and their peers who have less severe hearing losses.

While vision and lip-reading may be used to learn and understand language, it is important to discover what factors predict a child's ability to lip-read in order to better teach children who are hearing impaired language. De Filippo (1982) found that the most predictive measure of ability to lip-read sentences was a child's receptive language, as demonstrated through a reading test. However, Dood, McIntosh, and Woodhouse (1998) found that lip-reading ability could not predict language abilities. It was found that lip-reading skills do not predict receptive or expressive vocabulary (Dood, McIntosh, & Woodhouse, 1998).

Bergeson, Pisoni, and Davis (2005) looked to discover if age of cochlear implantation had an effect on lip-reading abilities. They found that, "children who experienced a longer period of profound deafness before implantation were better lip-readers than children who were profoundly deaf for shorter periods of time" (pp. 161). While the children participating in the Bergeson, Pisoni, and Davis (2005) study were experiencing a period of profound deafness before they received a cochlear implant, this data could also possibly apply to children who had a period of deafness before they received other forms of amplification, such as a hearing aid. Children who had a late identification or did not receive identification until late, may have experienced a period of time where they could not hear, and ultimately may be better lip-readers than those children who were identified early and received amplification immediately.

Ultimately, the age at which a child was identified with a hearing loss or the age at which the child received amplification may influence a child's ability to lip-read.

The duration of time a child has had amplification, whether it be a cochlear implant or hearing aids, could also influence lip-reading ability. Geers, Brenner, and Davidson (2003) tested 8 and 9-year-old children's lip-reading ability after five years of cochlear implant use. The *Children's Audio-Visual Enhancement Test* (Tye-Murray & Geers, 2001) was used to determine lip-reading ability. This test has children repeat words after a woman says them in the auditory only condition, the visual only condition, and the auditory-visual condition. They found that the children performed best in the auditory-visual condition, and the children had their poorest scores in the visual only condition (Geers, Brenner, & Davidson, 2003). Unfortunately, there are no scores to show the children's lip-reading ability either before or shortly after cochlear implantation.

Length of time wearing a device, such as a cochlear implant, could also influence the rate at which a child's lip-reading ability improves. Bergeson, Pisoni, and Davis (2005) found that as children had their cochlear implant longer (up to five years post-implantation), their auditory-visual and auditory only scores improved at a faster rate than their visual only scores. This suggests that after children have had their cochlear implant for a period of time, and they can hear speech, they are better able to use their hearing to understand speech and combine the visual modality and the auditory modality to best understand speech.

A child's educational placement is a difficult factor to investigate because every classroom is very different and the factors that make each classroom unique are difficult to quantify. Research has been conducted on reading ability and classroom placement with children who are hearing impaired. Geers and Brenner (2003) found that the children who had

hearing loss of less than 90 dB or who lost their hearing postlingually were typically placed in a mainstream classroom with hearing peers. These children performed better on reading tests than their peers who were hearing impaired and were not placed in classrooms with hearing peers. When coming to this conclusion, Geers and Brenner (2003) had controlled for age at onset and degree of hearing loss. Circling back to research by Mogford (1987) who found that language ability influences lip-reading ability, and knowing that language ability influences reading ability, one might conclude that the children in mainstream classrooms are better at lip-reading. This is because of the better reading scores and the knowledge that reading and language are closely connected. Unfortunately, it is difficult to conclude if the children were placed in mainstream classes because of their language ability or if they were placed there because they were better at lip-reading making them more proficient with spoken language and reading. Erber (1972) has conducted research on a child's ability use auditory and visual information together to improve the listening environment. He showed that children with hearing impairments are able to combine auditory and visual information to understand speech in poor listening environments.

The present study will attempt to discover if these factors and an assortment of other factors influence a child's ability to lip-read. It was hypothesized that the older children would be able to lip-read better than the younger children who participated in the study. It was also hypothesized that children who were identified after three years of age and subsequently did not receive amplification until after three years of age would have better scores on a test of lip-reading ability. Because some of the children were enrolled in private oral schools for the deaf and others were not, it was hypothesized that children who were currently enrolled in a private oral school for the deaf would not be as good at lip-reading as those children who were enrolled in other types of schools. The final hypothesis was two-fold. The children with better

standardized speech and language scores would be better lip-readers, while the children with poorer speech perception scores would be better lip-readers.

Purpose

The purpose of the present study was to determine if age, degree of hearing loss, school placement, early intervention, and amplification predicted children's scores on a test of lip-reading ability. Specifically, this study looked at the age of the child at the time of testing, the age at which a child was identified with a hearing loss, the age at which a child received amplification, the length of time a child had worn amplification, the age at which a child began intervention for their hearing loss, and the child's current educational placement. The study also considered the child's speech perception scores, receptive language scores, and standardized articulation scores as possible predictors of the child's lip-reading ability. Surveys filled out by the parents were used to obtain information about each child's history, and the information was compared with the child's scores on a test of lip-reading ability.

Methods

Subjects

Participants in this study were 67 children with hearing losses ranging from mild to profound. The children were ages 4 years, 10 months to 12 years, 2 months with a mean age of 7 years, 5 months. All of the participants were part of an ongoing study entitled *Auditory Speech Processing in Children* (NIH Grant #RO1 DC000421-16). Information about each of the participants can be found in Table 1.

Table 1. Information about the participants

Age (in months)	Gender	Degree of Hearing Loss*	WIPI Score (%)	Device Worn
59.31	F	Normal/Unilateral	100	None
76.67	M	Normal/Unilateral	100	HA
79.99	M	Normal/Unilateral	88	None
81.44	F	Normal/Unilateral	100	None
81.44	F	Normal/Unilateral	100	None
83.61	M	Normal/Unilateral	100	None
84.46	F	Normal/Unilateral	92	None
87.58	F	Normal/Unilateral	92	None
87.68	M	Normal/Unilateral	100	None
88.67	M	Normal/Unilateral	52	None
98.73	F	Normal/Unilateral	100	None
123.98	M	Normal/Unilateral	96	None
60.59	M	Mild	88	HA
61.97	M	Mild	72	HA
62.79	F	Mild	76	HA
98.53	F	Mild	72	None
103.69	M	Mild	96	HA
110.37	M	Mild	100	HA
115.46	M	Mild	92	HA
66.54	M	Mild-to-Moderate	96	HA
70.42	F	Mild-to-Moderate	24	HA
71.80	M	Mild-to-Moderate	100	HA
75.55	F	Mild-to-Moderate	76	HA
81.44	F	Mild-to-Moderate	60	HA
101.59	M	Mild-to-Moderate	100	HA
109.18	M	Mild-to-Moderate	60	HA
117.47	F	Mild-to-Moderate	100	HA
146.14	F	Mild-to-Moderate	100	HA
57.93	F	Moderate	80	CI
67.27	M	Moderate	88	HA
91.96	M	Moderate	88	HA
98.43	M	Moderate	64	HA
106.42	F	Moderate	80	HA
117.3	M	Moderate	88	HA

Table 1. Information about the participants (continued)

Age (in months)	Gender	Degree of Hearing Loss*	WIPI Score (%)	Device Worn
59.84	F	Severe	20	CI
60.95	F	Severe	52	HA
62.27	M	Severe	44	HA
67.23	F	Severe	76	CI
79.23	M	Severe	36	CI
88.47	M	Severe	44	HA
94.29	M	Severe	84	HA
99.95	F	Severe	76	CI
112.7	M	Severe	84	HA
129.67	M	Severe	76	HA
58.26	F	Profound	32	CI
67	M	Profound	36	CI
79.07	M	Profound	40	CI
83.93	M	Profound	80	CI
90.94	F	Profound	76	CI
93.57	M	Profound	80	CI
97.41	F	Profound	88	CI
98.66	M	Profound	60	CI
119.21	F	Profound	88	CI
123.25	F	Profound	32	CI
124.54	F	Profound	72	CI

*The categorization of each child's hearing loss was based on a table found in Tye-Murray (2004).

The parent or guardian of each child was asked to complete a survey about the child's audiologic and education history (Appendix A). Because the survey was designed after many of the children had come for their initial testing session, the surveys were mailed to parents along with a return envelope that had been addressed and stamped. Children who began the original study after the surveys had been mailed out were given the survey at the time of initial testing. A total of 35 surveys were mailed to parents using the address they had provided at the time of initial testing; the remaining 32 surveys were given to the parents at the time their child was first tested. Sixty-five surveys were completed by the parents and returned. One survey was returned

as undeliverable, and another survey was never returned. These two subjects have been excluded for the current sub-study due to insufficient data.

Because the surveys contained many open-ended questions, parents sometimes did not answer some portions of the survey, or the information they provided was incomplete. Therefore, some of the participants needed to be contacted by phone to clarify their answers. An attempt was made to contact all of the participants with incomplete answers. A number of the participants could not be contacted. Consequently, the analyses were conducted with data from only 55 participants.

Survey

A copy of the survey mailed to parents can be found in Appendix A. The survey was broken into four sections. The first section asked parents for information about the age at which their child was identified with a hearing loss and type of amplification (if any) with which their child was initially fitted. This section also asked parents questions about the infant/toddler program the child attended.

The second section was for parents to fill out if their child attended a preschool program specifically designed for children who are hearing impaired. We wanted to know how old the child was when he/she was enrolled in the program and for how long the child continued in the program. If the child did not attend a preschool program for children who are hearing impaired, there was a third section for the parents to fill out about the type of preschool their child did attend. Again, the questions asked the parents how old the child was when he/she began the preschool program and how long the child was enrolled in the program.

In the final section of the survey, parents were to answer questions about the child's current school placement. This section asked the parents how long the child had been at the

current placement and the type of classroom in which the child was enrolled. There were also questions about the services the child received at school either inside or outside the classroom and the services received after school. The final question on the survey asked if the child had ever had any formal lip-reading training. There was room at the bottom of the page and on the back of the survey for the parents to write any additional information they thought might be helpful.

Procedures

During the original study the participants were given the *Children's Auditory Visual Enhancement Test* (Tye-Murray & Geers, 2001), the *Peabody Picture Vocabulary Test*: *Third Edition* (Dunn & Dunn, 1997), and the *Goldman Fristoe 2: Test of Articulation* (Goldman & Fristoe, 2000) as part of the test battery. All of these tests (along with a variety of other tests) were randomly assigned an order to make up each child's testing protocol. The child was seated in a sound treated booth in front of a 19-inch computer monitor. The computer monitor was framed with red poster board to reduce distractions. A research assistant was seated in the booth next to the child.

The *Children's Auditory Visual Enhancement Test* (Tye-Murray & Geers, 2001) was given to the child under three conditions, auditory-only (A), visual-only (V), and audiovisual (AV). The audiovisual condition was always presented last, and based on the randomly assigned protocol, the child either received the auditory-only or visual-only condition first. The test was administered using a recorded voice presented through a loud speaker directly in front of the child and placed behind the computer monitor. Three word lists were presented with the carrier phrase, "Say the word". Performance in each condition was scored by counting the total number of words correctly repeated by the child. There were 20 words presented in each condition; 10

words that were considered to be easy and 10 words that were considered to be difficult (Tye-Murray & Geers, 2001).

Each participant was also given the *Peabody Picture Vocabulary Test: Third Edition* (PPVT—III) (Dunn & Dunn, 1997) to assess his or her receptive vocabulary. Again, this test was part of the larger protocol and the point at which it was given during the test battery was randomized. This standardized test was given to the participant at a table outside the sound treated booth. The child was seated across from the research assistant. The performance record was positioned so the child could not see his scores. Testing usually began one-year below the child's chronological age in order to establish a basal before beginning the test. Once the ceiling had been reached, the research assistant stopped the test and moved onto the next item on the protocol. After the participant left, the research assistant would score the test.

The *Goldman Fristoe 2: Test of Articulation* Sounds-in-Words portion of the test was given to all children who participated in the study. This test provides a systematic way of assessing each participant's articulation in the initial, medial, and final position of words (Goldman & Fristoe, 2000). The participant was seated in the sound treated booth with the research assistant during this test. The easel containing the pictures used as stimuli was placed on the table in front of the child. This portion of the test was audio taped in case there was any question about the child's speech production after the test was finished. The child was told that he/she would be naming some pictures, and that he/she needed to use their best speech. The total number of errors the child produces is the raw score.

All of the tests were scored by trained research assistants. The coding of the surveys was done by one research assistant for consistency. Several of the items on the surveys needed to be quantified. For example, "special education" was used as a category, and was considered any

age appropriate therapy or education designed specifically for a child with a hearing loss. If a child was two years old, then age appropriate education or therapy would be in home therapy or attending a nursery classroom. Age appropriate education or therapy for a six year old would be a school classroom for the deaf or a mainstream classroom with pull out speech therapy or a resource room. An itinerant teacher for hearing impaired children would also be age appropriate for a school-aged child.

The child's current educational placement was divided into four categories: private oral schools for the deaf; other classrooms for the deaf; a mainstream classroom with services; and a mainstream classroom without services. A child who attended a public school, but was in a self-contained classroom for students who were deaf, would be considered as having a placement in an "other classroom for the deaf". Children who are in a mainstream classroom, but are pulled out for physical therapy and speech therapy are considered to be in a "mainstream classroom with services".

Analysis and Results

A hierarchical regression analysis was conducted find the best predictors, out of multiple possibilities, of a single measure. Specifically, stepwise hierarchical regression attempts to find those independent variables that contribute the most to explaining the variability in a dependent variable. A stepwise regression model of this type will enter variables into the model as long as they continue to contribute a significant amount of additional explained variability in the dependent variable. In the current study, lip-reading ability was the dependent variable. The means of the independent variables are listed in Table 2. The breakdown of the children's current educational placement can be found in Table 3.

Table 2. Means for independent variables used in hierarchical regression analysis

	Mean	Standard Deviation
Age at Test	89 months	21.66
Duration of Amplification Use	47 months	31.98
Age at Identification	26 months	20.83
Age at beginning of Special Education	29 months	21.32
Age at Time of Amplification	32 months	20.05
WIPI	77%	22.73
Peabody Picture Vocabulary Test (Raw Score)	81	31.83
Goldman Fristoe Test of Articulation (Raw Score)	9	12.87

Table 3. Number of children in each category of current education placement

	Number of Children
Private Oral School for the Deaf	14
Classrooms for the Deaf not at a Private School	8
Mainstream Classroom with Services	21
Mainstream Classroom without Services	12

The partial correlations included in Table 3 provide a first indication of the independent contributions each make in explaining the variability among lip-reading scores. Note that the largest, independent, contributor to the model is Age at Test.

Table 4. Stepwise Hierarchical Regression Analysis

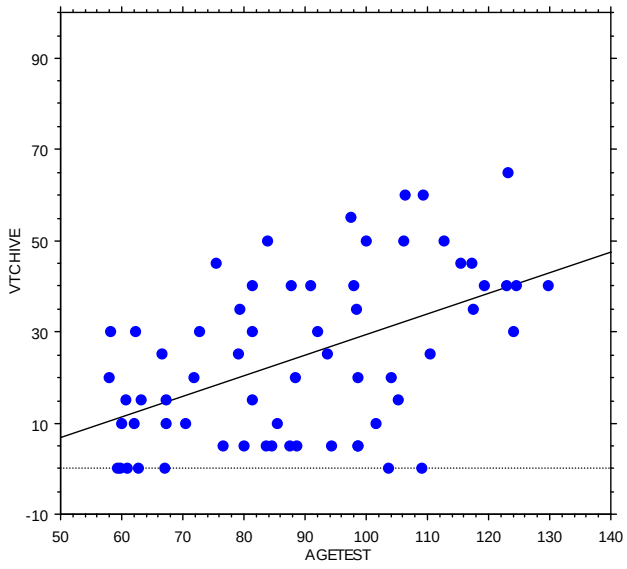
	Predictor	Additional explained variability in lip-reading ability	Total Explained Variance in lip-reading ability
Age at Test	*	19.4%	19.4%
Duration of Amplification Use	*	11.6%	31%
Age at Identification			
Age began Special Education			
Age at Amplification			
Current Educational Placement			
WIPI (%)			
Peabody Picture Vocabulary Test			
(Raw Score)			
Goldman Fristoe Test of Articulation			
(Raw Score)			

Of the nine variables, only two were found to provide a significant amount of independent contribution to explaining the variability in lip-reading scores. The first step in the model found that age at the time of testing explained 19.4% of the variance, $F(1, 54) = 13.0$; $p < .01$. The second step in the model found that the duration of time a child had worn amplification explained an additional 11.6% of the variance beyond what was explained by the child's age at the time of testing, f change $(1, 53) = 8.9$; $p < .01$. Together, the child's age at the time of testing and the length of time amplification had been worn, explained 31% of the variance among the

children tested, f (2, 53) = 11.9; p < .01. Beyond the 31% that could be explained by the two measures, no other measure included was able to explain any additional variance in the lip-reading scores. Graph 1 shows the lip-reading scores as a function of age.

Notably, the initial partial correlation between educational placement and lip-reading scores was high (see Table 4). The independent contribution, however, of the coded Educational Placement variable did not explain enough variability beyond the Age at Test and the Duration of Amplification variables.

Graph 1. Lip-reading scores as a function of age.



Discussion

Few studies have been conducted previously which examine a child's lip-reading ability, particularly when compared with their intervention and audiologic history. While only two of the factors were found to explain the variance, the information provided in both the significant and not significant findings is important. Early identification and intervention can improve the language abilities of a child who is hearing impaired (Yoshinaga-Itano, Sedey, Coulter, & Mehl, 1998). Unfortunately, the present study did not find any significant results showing a similar

improvement in lip-reading ability with age at identification, age at amplification, and age at enrollment in special education.

Regardless of age of identification, a child's age at the time of test was the strongest predictor of a child's ability to lip-read. The results indicated that the older the child was at the time of testing, the better their lip-reading scores will be. The second model showed that when looking at the length of time a child wore any device (either a hearing aid or a cochlear implant) compared to the child's lip-reading ability, a percentage of the variance was explained. This means that the length of time for which a child has worn a device predicts the child's ability to lip-read when the child's age at the time of testing has been removed as a variable. The age of the child at the time of testing and the length of time a child wore a device may be connected because older children could have theoretically worn a device longer than younger children.

These were the only two factors that significantly predicted a child's ability to lip-read. However, in the first model, the child's current educational placement was significant, but not significant enough to be the predicting factor. Therefore, a child's current educational placement could have an impact on lip-reading ability when certain factors are removed. Many classrooms in schools across the country could be considered to be poor listening environments. According to Erber (1972) auditory and visual information can be combined to optimize the listening environment. While the classroom could be seen as a poor listening environment because there is competing noise and most of the time the walls are not acoustically treated, classroom placement does not significantly account for the variance found among the children's lip-reading scores. This does not mean that children in certain types of classrooms are not better at combining visual and acoustic information; this result simply says that children in certain types of classrooms are not better at lip-reading only.

Bergeson, Pisoni, and Davis (2005) found that children who were older when they receive their cochlear implant were better lip-readers than those children who received their cochlear implants at a young age. This could possibly be because the children implanted at a younger age did not have to rely on the visual modality to understand speech for as long as the children who were older when they received their cochlear implant. This could also be the aging effect previously discussed, in which the older children perform better on tests of lip-reading ability simply because they are older and may have more experience with lip-reading.

While research has been conducted showing that language scores are both predictive and not predictive of lip-reading ability (De Filippo, 1982; Dood, McIntosh, and Woodhouse, 1998), the present study found that receptive language is not predictive of ability to lip-read. This was not a surprising result because the *Children's Auditory Visual Enhancement Test* (Tye-Murray & Geers, 2001) was designed to eliminate any bias that may be created by language ability. The lack of significance between these two entities may reflect the design of the test. The results also revealed that a child's ability to produce specific speech sounds was not predictive of the ability to lip-read. Finally, the words a child can identify through an auditory only task does not predict a child's ability to lip-read. This was surprising based on the results of Mogford (1987) and Geers and Brenner (1994) who found that children who had more hearing were better lip-readers and had better visual enhancement scores than those children who could not hear as much.

Study Limitations

This study is part of a larger, longitudinal study that is continually collecting data. Therefore, the children in this study were tested at a variety of points over a three-year period. The participants are all from the same area in the Midwest. While there is variance in each participant's socio-economic status, there is no significant geographical variation.

The surveys that were mailed out also contained some inadequacies. The biggest drawback of the surveys was the parents' interpretation of the questions. While every attempt was made to make the questions as clear and straightforward as possible, the questions were all open-ended allowing for each parent to interpret the question in a slightly different manner. In the future, it would be suggested that parent interviews be conducted allowing for clarification of answers.

Implications and Conclusions

Although all of the hypotheses were not confirmed, this study does show that as children get older and wear hearing devices longer, they become better lip-readers. If these children are educated in an auditory-oral setting they are exposed to lip-reading strategies on a daily basis. Teachers in these settings call attention to the shape and position of the mouth during speech providing the children with indirect lip-reading training. While the results of this study do not show that educational placement influences lip-reading ability, more statistical analyses could be run to determine if this training is benefiting the children and creating better lip-readers. By knowing what educational factors create children who are better lip-readers, parents and teachers of the deaf can create programs that will improve children's abilities to lip-read and ultimately lead to better language abilities of children who are deaf.

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References

Bergeson, T.R., Pisoni, D.B., & Davis, R.A.O. (2005). Development of audiovisual comprehension skills in prelingually deaf children with cochlear implants. *Ear & Hearing, 26*(2), 149-164.

De Filippo, C.L. (1982). Memory for articulated sequences and lipreading performance of hearing-impaired observers. *The Volta Review, 31*, 134-146.

Dodd, B., McIntosh, B., & Woodhouse, L. (1998). Early lipreading ability and speech and language development of hearing-impaired pre-schoolers. In R. Campbell, B. Dodd, & D. Burnham (Eds.), *Hearing by eye II: The psychology of speechreading and auditory-visual speech* (pp. 229–242). Hove, UK: Psychology Press.

Dunn, L.M., & Dunn, L.M (1997). *Peabody Picture Vocabulary Test: Third Edition*. Circle Pines, MN: American Guidance Service.

Erber, N.P. (1972). Auditory, visual, and auditory-visual recognition of consonants by children with normal and impaired hearing. *Journal of Speech and Hearing Research, 15*, 413-422.

Geers, A. & Brenner, C. (1994). Speech perception results: Audition and lipreading enhancement. *The Volta Review, 96*(5), 97-108.

Geers, A., Brenner, C., & Davidson, L. (2003). Factors associated with development of speech perception skills in children implanted by age five. *Ear and Hearing, 24*, 24S-35S.

Goldman, R., & Fristoe, M. (2000). *Goldman Fristoe 2: Test of Articulation*. Circle Pines, MN: American Guidance Service, Inc.

Mogford, K. (1987). Lip-reading in the prelingually deaf. In B. Dodd & R. Campbell (Eds.), *Hearing by eye: The psychology of lip-reading* (pp. 191-211). Hillsdale, NJ: Lawrence Erlbaum Associates.

Seewald, R.C., Ross, M., Giolas, T.G., & Yonovitz, A. (1985). Primary modality for speech perception in children with normal and impaired hearing. *Journal of Speech and Hearing Research, 28*, 36-46.

Tye-Murray, N. (2004). *Foundations of aural rehabilitation: Children, adults, and their family members* (2nd ed.). Clifton Park, NY: Thomson Delmar Learning.

Tye-Murray, N., & Geers, A. (2001). *Children's Audio-Visual Enhancement Test*. St. Louis, MO: Central Institute for the Deaf.

Yoshinaga-Itano, C., Sedey, A.L., Coulter, D.K., & Mehl, A.L. (1998). Language of early- and later-identified children with hearing loss. *Pediatrics, 102*, 1161-1171.

Appendix A

Education History

How old was your child when he/she was identified with a hearing loss? _____

What type of device was your child fitted with at this time, if any? _____

Was your child enrolled in an infant/toddler program for hearing impaired children? _____

How old was your child when he/she received this intervention? _____

Where did the first intervention take place? _____

How often did this intervention occur? _____

When did this therapy or intervention end? Why? _____

Was your child ever enrolled in a preschool program for hearing impaired children? _____

How old was your child when they were enrolled in this program? _____

Where was your child enrolled in this program? _____

For how long was your child enrolled in this program? _____

If your child was not enrolled in a preschool program for hearing impaired children, was your child enrolled in any other preschool or day care program? _____

How old was your child when they were enrolled in this program? _____

Where was your child enrolled in this program? _____

For how long was your child enrolled in this program? _____

Where is your child currently enrolled in school? _____

Is this a public or private school? _____

How long has your child been at his/her current school? _____

What grade is your child currently enrolled in (if applicable)? _____

In what type of classroom is your child enrolled? _____

Does your child receive any type of therapies/services outside of the classroom during the school day? If yes, what type of services? _____

Does your child receive any additional services or therapies outside of school? _____

If yes, what types of services? _____

Has your child ever received any formal training in lip reading? _____

If there is any additional information about your child's educational history, particularly with regards to his/her hearing loss, please make note of this information here (use the back if necessary).